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COUNTER CURRENT DIFFUSION EXTRACTOR

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(71) Applicant(s)
PROCESSING TECHNOLOGIES INTERNATIONAL LIMITED

(72) Inventor(s)
TIMOTHY RALSTON LANG

(74) Attorney or Agent
PHILLIPS ORMONDE & FITZPATRICK , 367 Collins Street, MELBOURNE VIC 3000

(56) Prior Art Documents
US 4363264
US 3726209
US 3529938

(57) Claim

1. A counter current extractor comprising an elongate housing with a screw conveyor therein and having strainer means at one end thereof to filter a liquid phase passing out of the counter current extractor, wherein the strainer means is provided with clearing means to prevent the strainer means from remaining clogged with particulate materials, and wherein the clearing means includes one or more liquid jets which eject liquid so as to dislodge particulate material from the strainer means.

13. A counter current extractor comprising an elongate housing in the form of a trough or tube, and having a solid phase inlet at or adjacent a first end and a solid phase outlet at or adjacent a second end, a screw conveyor disposed within the housing and rotatable about its longitudinal axis to move solid phase material introduced into the housing from the said first end to the said second end, means for introducing an extracting liquid into the said second end of the housing wherein the extracting liquid is spilled into the housing so as to flow in a cascade

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over and through the solid phase material to the said first end. drive means to cause the screw conveyor to rotate. strainer means to separate a liquid phase leaving the housing from the solid phase material entering the housing. and clearing means to keep the strainer means substantially clear of solid particles wherein the clearing means comprises one or more liquid jets. whereby liquid may be sprayed onto said wire screen at sufficient velocity to dislodge larger solids from the screen into the bulk of the solid phase material. whilst smaller solids are pushed through the screen into the outflow of the extracting liquid, while the strainer means is adapted to rotate so that different portions of the strainer means are presented to the clearing means, and wherein the level of the extracting liquid at the first end of the housing is maintained at a predetermined level by control means.

IN

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(71) Applicant (*for all designated States except US*): PROCESSING TECHNOLOGIES INTERNATIONAL LIMITED [BM/AU]; 2/1051 Pacific Highway, Pymble, NSW 2073 (AU).

(72) Inventor; and

(75) Inventor/Applicant (*for US only*): LANG, Timothy, Ralston [AU/AU]; 2/1051 Pacific Highway, Pymble, NSW 2073 (AU).

(74) Agent: PHILLIPS ORMONDE & FITZPATRICK; 367 Collins Street, Melbourne, VIC 3000 (AU).

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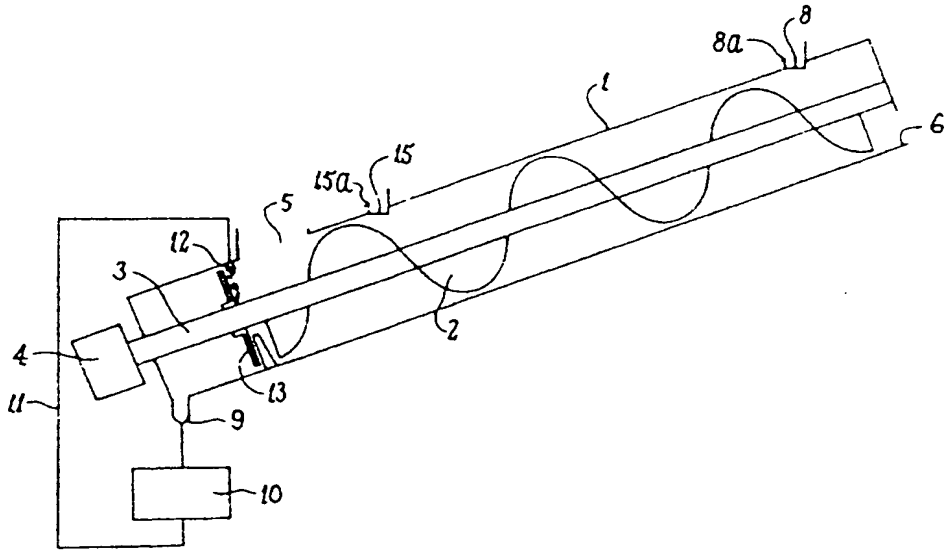

(57) Abstract

A counter current extractor comprising an elongate housing with a screw conveyor therein and having strainer means at one end thereof to filter a liquid phase passing out of the counter current extractor, wherein the strainer means is provided with clearing means to prevent the strainer means from remaining clogged with particulate material and wherein liquid being fed into the counter current extractor is spilled into the counter current extractor so as to flow in a cascade over and through a solid phase in the counter current extractor, said liquid being maintained at a desired level by control means.

COUNTER CURRENT DIFFUSION EXTRACTOR

The present invention relates to an improved counter current extractor having improved flow characteristics.

Counter current extractors (CCE's) are well known in the food processing industry for the continuous extraction of liquids, solubles, and fine particulate matter from associated solids. Such extractors may comprise a screw conveyor or pair of parallel counter rotating screw conveyors mounted within an inclined or vertical elongate housing, which takes the form of a trough or enclosed tube. Material to be processed is fed into the lower end of the housing and carried upward by screw rotation while an extracting liquid is fed into the top of the housing via spray jets and flows downwards under gravity. An example of this type of extractor is found in U.S. Patent No. 4,363,264, which is incorporated herein by reference.

When the solid phase material reaches the top end of the housing, it is removed from the housing, either by a slat-type conveyor, or by being pushed up a ramp by the material being expelled behind it. The solid phase material may be pressed to remove liquid entrained therein, and this liquid is returned to an intermediate position of the CCE trough.

Generally, strainer means are provided to filter large particles of the solid phase from the extract liquid prior to its removal from the lower end of the housing. Problems have arisen in the past with particles of solid matter being trapped against the strainer means by the pressure of liquid flowing through the strainer means, thus blocking flow. This is particularly so where the material to be processed is added cold, so that increased quantities of hot recycle liquid are required to heat the material to improve extraction.

Another problem which arises from increased extracting liquid flow is the tendency of the solid phase to disintegrate under the higher spray pressure of the extracting liquid as it enters the CCE extractor. This contributes to the amount of small particulate matter within the extractor which causes blockage of the strainer

means. In addition small particulate matter can create a blockage or reduce the porosity of the solids phase itself through the entire length of the CCE. This in turn reduces the flow rate of the liquid phase down the CCE in relation to the flow rate of the solid phase moving up the CCE, resulting in a high liquid retention level throughout the CCE causing the liquid to by-pass the solid phase resulting in higher dilution and lower yield.

Whilst it is desirable to ensure that the liquid phase passes freely through the retaining means, it is also desirable that a controlled amount of liquid be retained in the lower regions of the housing to enhance the solid/liquid contact in the vicinity of the solids charging point. In many, if not all applications, when solids are first added to the CCE, there is a net uptake of liquid into the solid phase, resulting in an increase in mass and volume of the solid phase. Whilst not wishing to be bound to any theory of operation, it is believed that where fruit, for example, enters the CCE with live, intact cell walls, osmotic pressure drives water into the cell, whilst the still organised cell wall ejects soluble compounds into the extracting liquid. After an initial uptake of water, lysing of the cell due to heat occurs, releasing the cytoplasm and added water. A similar effect is noted for dry material such as coffee beans, due to the hygroscopic nature of the material, rather than osmosis. No subsequent release of water occurs in this case.

The transfer of liquid into and out of the solid phase is believed to have a significant effect on both concentration of the extract and the yield of soluble components transferred from the solid to the liquid phase. By controlling liquid level during the early processing of the solid phase, improved extraction can be achieved.

The present invention seeks to provide means for alleviating or overcoming one or more of these problems. Accordingly, there is provided a CCE having a strainer means at one end thereof to filter a liquid phase passing out of the CCE, wherein the strainer means is provided

with clearing means to prevent strainer means from remaining clogged with particulate material. The clearing means may include one or more liquid jets which eject liquid so as to clear the strainer means, or one or more wiping members which physically dislodge material from the strainer means. Both liquid jets and wiping members may be used in conjunction.

A further embodiment of the invention provides a CCE having liquid feed means so that a cascade of hot juice flows over the material to be processed as it is conveyed through the CCE housing by the screw.

In a preferred embodiment of the invention, there is provided a CCE including an elongate housing in the form of a trough or tube, and having a solid phase inlet at or adjacent a first end and a solid phase outlet at or adjacent a second end, a screw conveyor disposed within the housing and rotatable about its longitudinal axis to move solid phase material introduced into the housing from the said first end to the said second end, means for introducing an extracting liquid into the said second end of the housing and to cause it to flow along the housing to the said first end, drive means to cause the screw conveyor to rotate, strainer means to separate a liquid phase leaving the housing from the solid phase material entering the housing, and clearing means to keep the strainer means substantially clear of solid particles wherein the clearing means comprises one or more liquid jets, whereby liquid may be sprayed onto said wire screen at sufficient velocity to dislodge larger solids from the screen into the bulk of the solid phase material, whilst smaller solids are pushed through the screen into the outflow of the extracting liquid, while the strainer means is adapted to rotate so that different portions of the strainer means are presented to the clearing means, and wherein the level of the extracting liquid at the first end of the housing is maintained at a predetermined level by control means.

The liquid jets are preferably flat fan jets positioned such that the spray from the jets forms a

lateral cho[redacted] across the strainer means [redacted] proximately one third of the way from the top of the strainer means. The jets are preferably angled at approximately 25-45° from the plane of the strainer means, and are directed downwardly onto the screen. It is preferred that the liquid used is obtained from a balance tank used to store the extracting liquid which is discharged from the first end of the counter current extractor.

The wire screen is preferably unobstructed across its entire screening area and has apertures, the minimum dimensions of which range from about 2.5 millimetres to 10 millimetres, but are normally about 4 millimetres. It is preferred that the apertures are wider on the downstream side of the strainer means and this is achieved by using wedge wire to form a screen with a flat sided profile on the top-side or product solids side of the screen so that the smaller solids will clear easily through the wider profile on the bottom side or liquid side of the screen. The screen is made up of several segments so that the wedge wire forms a radial pattern out from the main screw shaft or axis. This has been designed in this pattern so that as the screen rotates, the liquid jets strike the flat profile of the screen at an angle of approximately 35°, causing the solids, that are pressed against the flat surface, to peel off the screen in a continuous roll back into the main body of solids in the CCE. As the screen rotates further the wedge wire presents longitudinally or vertically in relation to the liquid jets so that the high velocity liquid spray will pass through the screen taking the smaller solid particles along with it, leaving the screen clear and ready to be re-submerged into the liquid and solids in the lower segment of the CCE.

In a further preferred embodiment, a driving shaft for the screw conveyor projects through the wire screen. Clearing means are attached to the driving shaft so as to rotate therewith, said clearing means being at least one wiper member in close juxtaposition with the wire screen so as to clear solid phase material from the wire screen. The wiper member may comprise one or more blades extending

radially from the driving shaft sufficiently close to the wire screen to dislodge solid phase material therefrom.

The clearing means may comprise a liquid jet and a wiper member in conjunction.

It will be appreciated that rather than having a fixed wire screen with rotating clearing means, the wire screen may be fixed to the driving shaft to rotate therewith, whilst the clearing means remains stationary to achieve the same effect.

In another embodiment of the invention, the liquid feed means for introducing liquid into the housing comprises a reservoir having a weir arranged laterally across said elongate housing such that extraction liquid introduced into the reservoir spills over the weir and flows in a cascade over and through the solid phase material as said material is conveyed by the screw conveyor from the first end toward the second end of the counter current extractor. This avoids the spray of extracting liquid onto the solid phase of prior art methods and thereby reduces breakup of the solid phase.

Means are preferably provided for recycling extracting liquid from the first end of the housing, heating it to some desired temperature and returning it via liquid feed means to the housing at a point between the first end and the second end of the housing. A suitable proportion of the extracting liquid discharged from the lower end of the housing is desirably diverted through an independent heat exchanger where it is heated and recirculated to the housing at some point above the said first end. As the objective is to achieve rapid heating of material at an early stage of processing, the heated, recirculated extraction liquid should be introduced into the lower half of the housing, preferably at a point from about one twentieth to about one quarter the length of the housing from the said first end.

Suitable liquid level control means may comprise an adjustable height outlet within the counter current extractor trough, requiring liquid to reach the height of the outlet before exiting the trough. Similar control

means may comprise an adjustable height inlet into a balance reservoir tank in which liquid is kept for recirculation purposes. This allows the outlet from the counter current extractor trough to be flush with the bottom of the trough, aiding in cleaning of the trough. Because the inlet to the balance tank is adjusted to be higher than the bottom of the counter current extractor trough, liquid pools in the trough until reaching the level of the inlet to the balance tank. A further method for controlling the liquid level is by use of a level sensing control system. The required liquid level is programmed into a programmed logic control (PLC) unit. The PLC unit monitors the liquid level using, for example, an ultrasonic sensor and opens or closes a motorised liquid outlet valve so as to maintain a constant level.

The housing of the extractor is preferably provided with a jacket through which a fluid may be passed. In this way the temperature of the housing and to some degree the temperature of the contents thereof may be controlled.

The extracting liquid will frequently be water; however, other liquids including organic liquids or aqueous or organic solutions could be used. The process may be used for the extraction of soluble or dispersible material from fruit or vegetable matter such as sugarbeet, sweet sorgum, grapes, grape marc or grape pomace, tea, citrus fruit, citrus peel, apples, pears, coffee beans, vanilla beans, and from animal matter such as fish heads and offal. Residue material such as apple peels and cores, citrus peel and grape marc or grape pomace may also be exhaustively extracted to recover valuable soluble components which are normally discarded with these residues. Soluble sugars recovered from apple or pear peels and cores could be used in the preparation of canning syrups or fermented to alcohol. Other residues contain material such as flavouring, colours or specific useful materials such as pectins which may be recovered. For satisfactory extraction, it is preferred that the materials are in a particulate form, the shape of the particles being such that the diffusion path for the

migration of the soluble material out of the particles is short in at least one direction.

Tests show that the improvements of the invention result in a marked increase in extract concentration. Before introduction of clearing means for the strainer means, liquid extract was either more diluted than expected, or recovered in smaller quantities, or both. Clearing of blocked strainer means required about 20 minutes downtime, with a corresponding drop in production capacity for a given CCE.

Introduction of liquid jets to clear the strainer means of a CCE used to extract solubles from citrus peel resulted in concentration of solubles in extract liquid streams increasing from 3.5° to 4.5° Brix. Yield increased from 20kg soluble solids per tonne of peel to 22kg soluble solids per tonne of peel, and the capacity of the counter current extractor increased from 4.5 tonnes per hour to 5.0 tonnes per hour.

Further improvement may be obtained by using a weir distribution system for recycle and extracting liquids. Soluble material concentrations obtained using this further improvement are above 4.5° Brix, usually about 6.5° Brix and even as high as 8.0° Brix.

Hereinafter given by way of example only is a preferred embodiment of the invention described with reference to the accompanying drawings, in which:

Figure 1 is a semi-schematic diagram of a counter current extractor according to the present invention.

Figure 2 is a semi-schematic diagram of part of a counter current extractor according to a further embodiment of the invention.

Figure 3 is a cross-section of a counter-current extractor trough showing one embodiment of the level control means.

Figure 4 is a cross-section of a counter-current extractor trough and associated balance juice tank showing a further embodiment of the liquid control means.

Figure 5 is a diagramatic cross-section of a CCE and associated balance juice tank showing a further

embodiment of the liquid control means.

As seen in Figure 1, the counter current extractor comprises a elongate housing 1 in which is disposed a screw conveyor comprising a driving shaft 3 having a helical flight 2 disposed about it and a drive means 4 to rotate the driving shaft 3 about its longitudinal axis. The elongate housing has a solid phase inlet 5 and solid phase outlet 6. Solid material to be extracted is supplied to the elongate housing through inlet 5 and conveyed by the helical flight 2 to the outlet 6. Extracting liquid is supplied to the lateral channel 8 from which it flows over weir 8a and then through the elongate housing to liquid phase outlet 9. The liquid phase must pass through screen 13 before reaching outlet 9, screen 13 having small aperatures therein to separate solid phase material from the extracting liquid. A portion of the extracting liquid flows from outlet 9 to balance tank 10 from whence it is pumped via line 11 to liquid jets 12 which direct the liquid laterally onto screen 13 at sufficient velocity to dislodge solid phase particles therefrom. Further heated extracting liquid may also be provided to the elongate trough 1 by means of a further lateral channel 15 and weir 15a, to heat the solid phase upon entry into the trough 1 to improve extraction.

Figure 2 shows an alternative embodiment of the invention wherein screen 13 is cleared of solid phase particles by means of blades 14 which are attached to driving shaft 3 so as to rotate therewith. As blade 14 is immediately adjacent screen 13, the movement of blade 14 past screen 13 dislodges solid phase particles from screen 13.

It is also envisaged that embodiments of the invention having a rotating screen may have both liquid jets 12 and a blade 14 together.

In Figure 3, a liquid control means is illustrated, comprising an inner tube 16 slidably mounted in an outer tube 17. The end 18 of tube 17 may be adjusted so that depth of the liquid, corresponding to distance d between the bottom of trough 1 and end 18 may be varied. Tube 16

is held in place by compression sealing means 19, comprising a threaded flange 20 at the end of tube 17, a compressible member 21 and a collar member 22 adapted to be screwed onto the threaded flange 20, thereby compressing compressible member 21 to seal the end of outer tube 17 and retain inner tube 16 in position.

Figure 4 shows an alternative liquid level control means which has a flush mounted liquid exit 23, allowing a liquid level of zero or greater possible and making cleaning of the trough 1 easier. Liquid exits the trough 1 via exit 23 and passes through valve means 24 to the outer tube 25. Valve means 24 may also be set to allow liquid to pass into a washout drain 26 during cleaning. The outer tube 25 has an inner tube 27 slidably mounted therein, tubes 25 and 27 being provided with sealing means 28 to prevent leakage between the tubes. The height of end 29 of tube 27 may be adjusted by adjustment means 30, which is held in position by locking screw 31. Because the end 29 is above the liquid exit 23, the depth of the liquid d in trough 1 is controlled by adjusting the height of end 29. Liquid flows from end 29 into balance tank 10, from which it is removed via pump outlet 32. An overflow tube 33 is provided to control overfilling of balance tank 10. In some embodiments, several pump outlets may be provided for the juice, eg. a finished juice outlet, a recycle juice outlet and a screen spray outlet.

Figure 5 shows an ultrasonic level sensor 34 mounted above trough 1. Level sensor 34 is attached to a programmed logic control (PLC) unit 35, into which the desired liquid level has been programmed. In response to information provided by the level sensor 34, the PLC unit 35 opens or closes a motorized valve 36, allowing liquid to flow into balance tank 10.

The claims defining the invention are as follows:

1. A counter current extractor comprising an elongate housing with a screw conveyor therein and having strainer means at one end thereof to filter a liquid phase passing out of the counter current extractor, wherein the strainer means is provided with clearing means to prevent the strainer means from remaining clogged with particulate materials, and wherein the clearing means includes one or more liquid jets which eject liquid so as to dislodge particulate material from the strainer means.

2. A counter current extractor according to claim 1 wherein the clearing means includes at least one liquid jet which ejects liquid so as to dislodge particulate material from the strainer means and at least one wiping member which physically dislodges particulate material from the strainer means.

3. A counter current extractor according to claim 1 wherein the strainer means comprises a circular wire screen having apertures therein, the minimum dimension of which ranges from approximately 2.5 mm to 10 mm and wherein the wire screen is formed of wedge wire so that a substantially flat profile is created on the upstream side of the screen and the apertures are wider on the downstream side of the screen than the upstream side of the screen.

4. A counter current extractor according to claim 3 wherein the liquid jet is a flat fan jet arranged so that the spray from the jet strikes the strainer means substantially downwardly at an angle of between approximately 25° to 45° from the plane of the strainer means, so as to define a chord across the circular strainer means.

5. A counter current extractor according to claim 4 wherein the spray from the jets strikes the strainer means at approximately 35° from the plane of the strainer means so as to define a substantially horizontal chord approximately 1/3 of the way from the top of the strainer means.

6. A counter current extractor according to claim 3 wherein the circular wire screen is adapted to rotate about its axis so as to present different portions of the screen to the liquid jet.

7. A counter current extractor according to claim 6 wherein the circular wire screen is attached to a driving shaft of the screw conveyor so as to rotate therewith.

8. A counter current extractor according to claim 2 wherein the strainer means comprises a circular wire screen having apertures therein, the minimum dimension of which ranges from approximately 2.5 mm to 10 mm and wherein the wire screen is formed of wedge wire so that a substantially flat profile is created on the upstream side of the screen and the apertures are wider on the downstream side of the screen than the upstream side of the screen.

9. A counter current extractor according to claim 8 wherein the wiping member is a stationary blade abutting the upstream side of the wire screen and wherein the wire screen is adapted to rotate about its axis so that as different portions of the wire screen move past the stationary blade, particulate matter is dislodged from the screen by the blade.

10. A counter current extractor according to claim 9 wherein the circular wire screen is attached to a driving shaft of the screw conveyor so as to rotate therewith.

11. A counter current extractor according to claim 8 wherein the wiping member is a rotating blade abutting the upstream side of a stationary wire screen so that as the blade moves past different portions of the wire screen, particulate matter is dislodged from the screen by the blade.

12. A counter current extractor according to claim wherein the rotating blade is attached to a driving shaft of the screw conveyor so as to rotate therewith.

13. A counter current extractor comprising an elongate housing in the form of a trough or tube, and having a solid phase inlet at or adjacent a first end and a solid phase outlet at or adjacent a second end, a screw conveyor disposed within the housing and rotatable about its longitudinal axis to move solid phase material introduced into the housing from the said first end to the said second end, means for introducing an extracting liquid into the said second end of the housing wherein the extracting liquid is spilled into the housing so as to flow in a cascade over and through the solid phase material to the said first end, drive means to cause the screw conveyor to rotate, strainer means to separate a liquid phase leaving the housing from the solid phase material entering the housing, and clearing means to keep the strainer means substantially clear of solid particles wherein the clearing means comprises one or more liquid jets, whereby liquid may be sprayed onto said wire screen at sufficient velocity to dislodge larger solids from the screen into the bulk of the solid phase material, whilst smaller solids are pushed through the screen into the outflow of the extracting liquid, while the strainer means is adapted to rotate so that different portions of the strainer means are presented to the clearing means, and wherein the level of the extracting liquid at the first end of the housing is maintained at a predetermined level by control means.

14. A counter current extractor according to claim 1, substantially as hereinbefore described with reference to any one of Figures 1 to 5.

DATED 24 July, 1998

PHILLIPS ORMONDE & FITZPATRICK
Attorneys for:
PROCESSING TECHNOLOGIES INTERNATIONAL LIMITED

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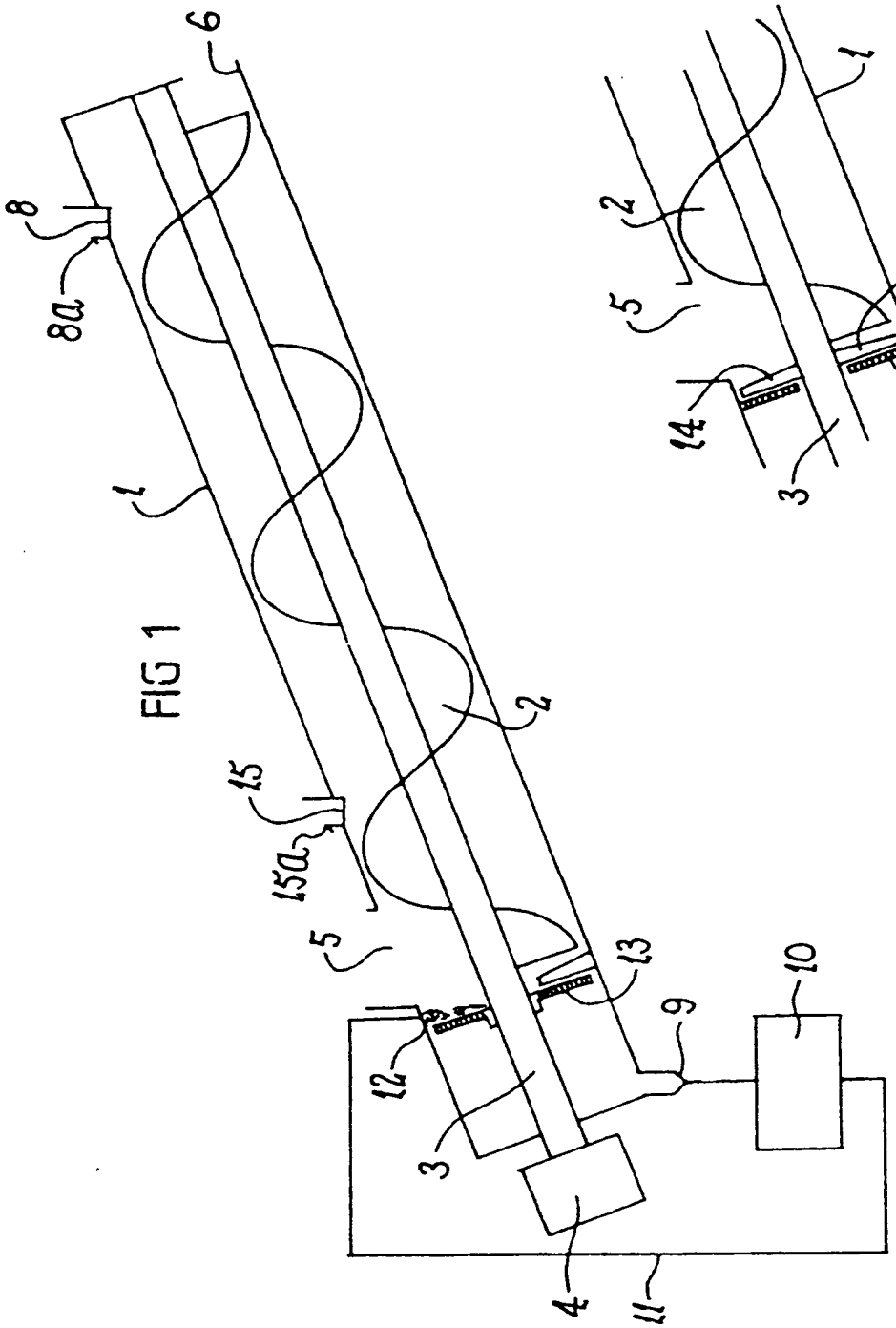


FIG 1

FIG 2

FIG 3

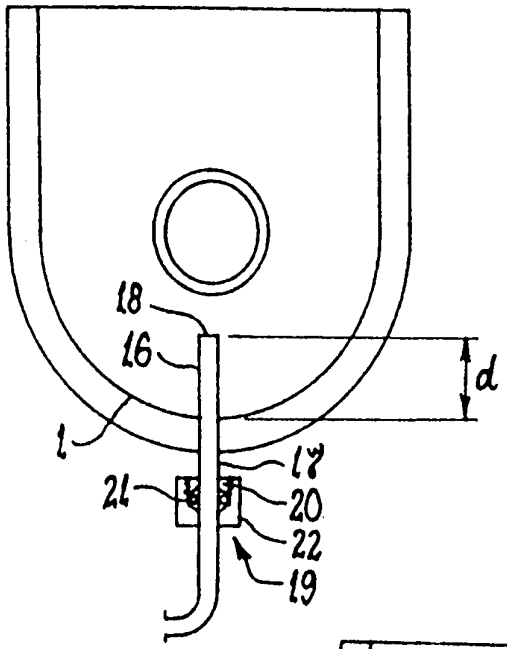
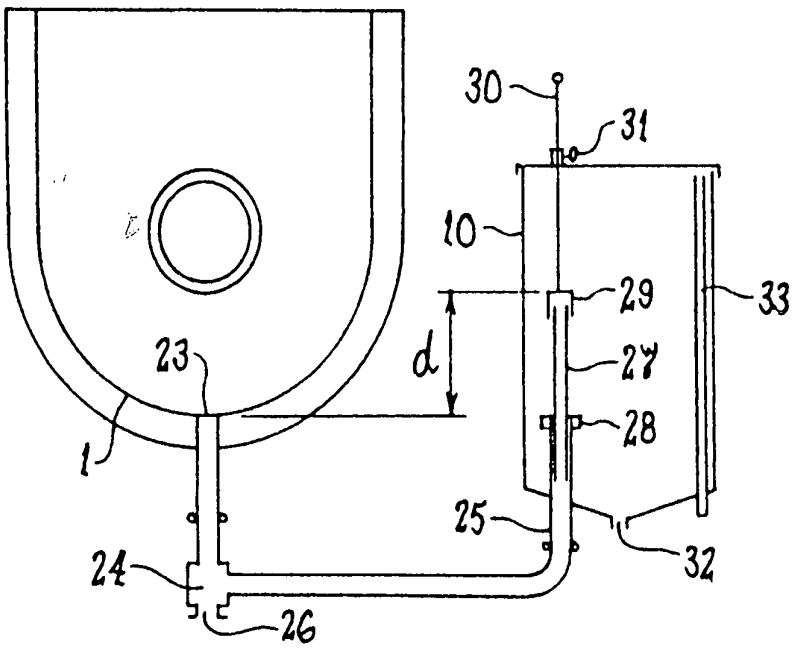


FIG 4



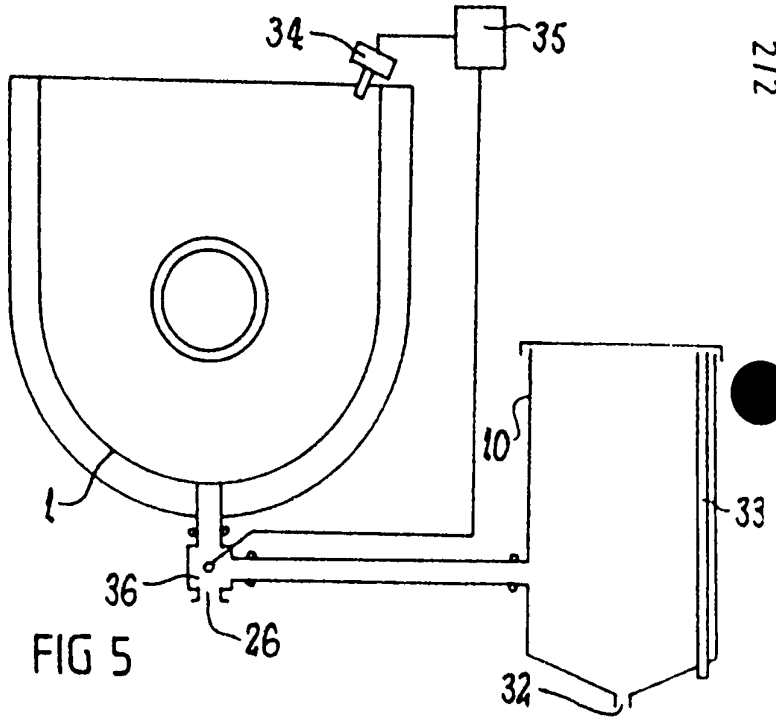


FIG 5

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A. **CLASSIFICATION OF SUBJECT MATTER**

Int. Cl.[5] A23F 3/18, 5/26, A23L 1/2[redacted]222, 1/312, 1/313, 1/327, A23N 1/00, B01D 1[redacted]

According to International Patent Classification (IPC) or to both national classification and IPC

B. **FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC B01D 11/02, A23F 1/08, 3/02, A23N 1/00 (1920-1974) see below also.

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

AU:IPC B01D 11/02, A23F 3/16, 3/18, 5/24, 5/26, A23N 1/00

Electronic data base consulted during the international search (name of data base, and where practicable, search terms used)

See extra sheet

C. **DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
X	US,A, 4363264 (LANG et. al.) 14 December 1982 (14.12.82) column 2 lines 24-37, 52-61	1,3,8,9, 15-21
X	US,A, 2587556 (WEISS et. al.) 26 February 1952 (26.02.52) column 2 lines 45-50, column 3 lines 60-66, column 4 lines 40-65	1,3, 13-21
X	US,A, 3529938 (YOON et. al.) 22 September 1970 (22.09.70) column 4 lines 66-71, claim 3	1,3,13,14
X	US,A, 3726209 (STOLTZE et. al.) 10 April 1973 (10.04.73) claim 1	1,3,13,14

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
26 August 1994 (26.08.94)	15 Sept 1994 (15.09.94)

Name and mailing address of the ISA/AU

AUSTRALIAN INDUSTRIAL PROPERTY ORGANISATION
PO BOX 200
WODEN ACT 2606
AUSTRALIA

Facsimile No. 06 2853929

Authorized officer

M. Bremers

M. BREMERS

Telephone No. (06) 2832052

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate of the relevant passages	Relevant to Claim No.
X	US,A, 4289579 (FORSBERG) 15 September 1981 (15.09.81) column 6 line 30 - column 7 line 31	1,2,15-21
X	US,A, 3857332 (HOUGHTON-LARSEN et. al.) 31 December 1974 (31.12.74) column 3 lines 18-21	15
X	US,A, 2629663 (FOGLER et. al.) 24 February 1953 (24.02.53) column 4 lines 51-68	15-21
X	GB,A, 914473 (FMC CORP) 2 January 1963 (02.01.63) Page 2 line 104 - page 3 line 7	17-21
X	AU,A, 23670/92 (LANG) 4 February 1993 (04.02.93) Page 5 lines 27-39	15-21
Y	Whole document	1,2
Y	Derwent Abstract Accession No. 12899W/08, Class J01, DT,A, 2337916 (BLAW-KNOX) 13 February 1975 (13.02.75) Abstract and DT,A, 2337916 (BLAW-KNOX) 13 February 1975 (13.02.75) Fig. 3	1,2 1,2

Continuation of

Electronic data base searched

Keywords: KWI - counter()current or countercurrent or

counter()flow or counterflow or

counter()stream or counterstream

KW2 - strain: or filter: or screen: or grid or retain

IPC: B01D 11/02, A23F 1/-, 3/-, 5/- A23L 1/-, A23N 1/00, A24B 15/-

DERWENT: (i) IPC and KWI and KW2

(ii) (IPC and KWI) BUT NOT (IPC and KW2)

JAPIO: IPC and KWI

Box I **Observations where certain claims were found unsearchable (Continuation of Item of first sheet)**

This international search report has not established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claim Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II **Observations where unity of invention is lacking (Continuation of item 2 of first sheet)**

This International Searching Authority found multiple inventions in this international application, as follows:

(i) Claims 1-14 and 22

(ii) Claims 15-16 and 22

(iii) Claims 17-22

Claims 1-14 define a counter current extractor having a strainer with a clearing means.

Claims 15 and 16 define a counter current extractor having a liquid feed means wherein the liquid cascades over the solid phase.

Claims 17-21 define a counter current extractor wherein the liquid phase level in the extractor housing is maintained by a control means.

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically

claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☒ No protest accompanied the payment of additional search fees.

(continuation) of Box II

Claim 22 defines a counter current extractor having the characterising features of the independent claims 1, 15 and 17.

Unity exists between (i) claims 1-14 and 22 or between (ii) claims 15-16 and 22 or between (iii) claims 17-21 and 22 but not between claims 1-14 and 15-16 and 17-21.

The feature common to all of the claims is a counter current extractor. However, this feature is not novel because it is disclosed in US,A, 4363264 (LANG et. al.) 14 December 1982 (14.12.82). At page 1 lines 4-16 it is admitted that this is known.

Consequently, the common feature is not a special technical feature within the meaning of PCT Rule 13.2 since it makes no contribution over the prior art.

Therefore, there is no other feature common to all the claims. Since there exists no other common feature which can be considered as a special technical feature within the meaning of PCT Rule 13.2 second sentence, no technical relationship within the meaning of PCT Rule 13 between the different inventions can be seen.

Consequently, it appears that, a posteriori, claims 15 and 16 and claims 17-21 do not satisfy the requirement of unity of invention with claims 1-14.

This Annex lists the known "A[redacted]blication level patent family members re[redacted]g to the patent documents cited in the above-mentioned i[redacted]national search report. The Australian Pa[redacted] Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
US	4363264	AT	3014/81	BR	8104283	CA	1158840
		CH	641368	DE	3126756	DK	2973/81
		ES	504204	ES	8300484	FI	812083
		FR	2485942	GB	2079176	IL	63244
		IN	154629	IT	1137290	JP	57156002
		NL	8103248	NZ	197557	PH	18481
		PL	232078	AU	72358/81		
US	3726209	DE	2000311	FR	2027993	GB	1255462
US	4289579	FI	783812	SE	7714043	WO	7900375
US	3857332	DE	2252547	FR	2158310	GB	1372960
		JP	48053970				
AU	23670/92	CN	1070835	EP	604446	IL	102569
		MX	9204255	WO	9301729		

END OF ANNEX